

PRELIMINARY DATA SUMMARY

April 1992

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

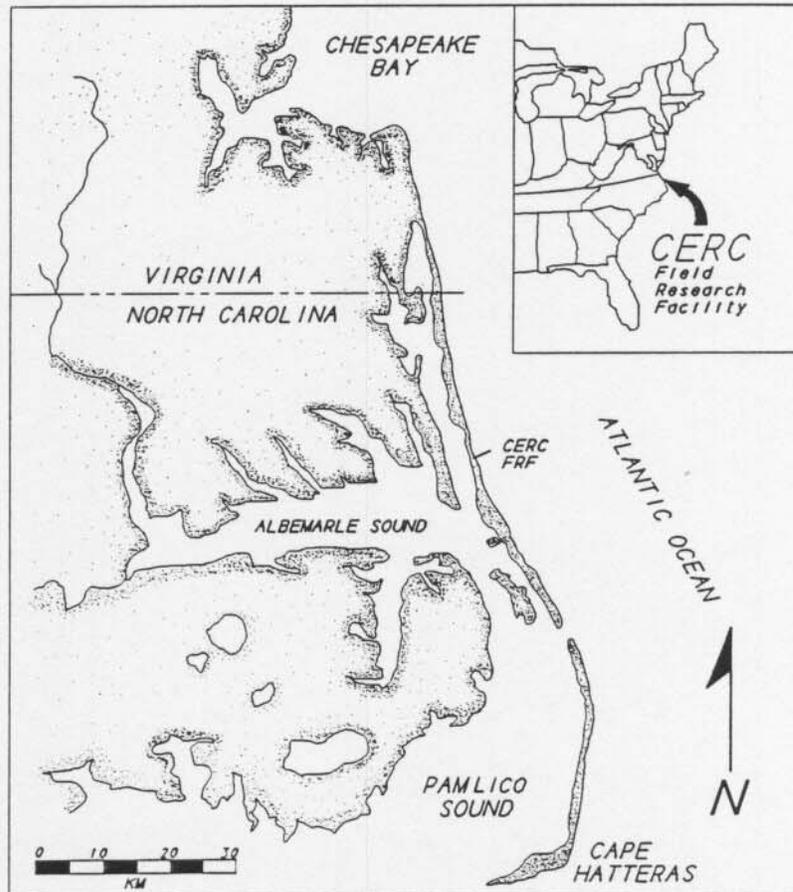
One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).





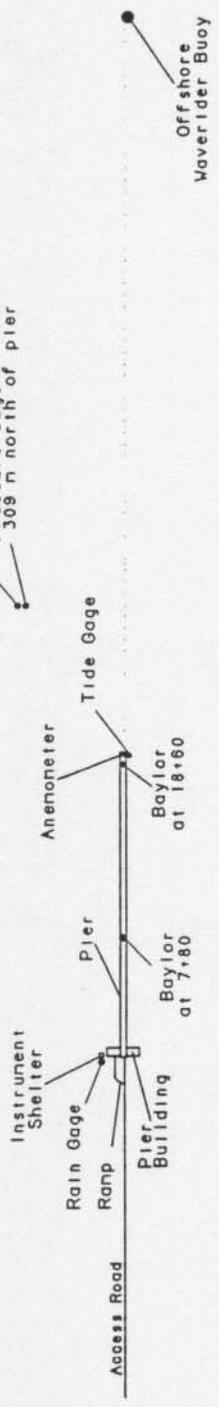


Pier Building at 0+40 to 1+00

12 Inch Rain Gage at 0+30

Instrument Shelter at 0+40

Current Meter  
320 m north of pier  
Pressure Gage  
309 m north of pier



CURRITUCK SOUND

ATLANTIC OCEAN

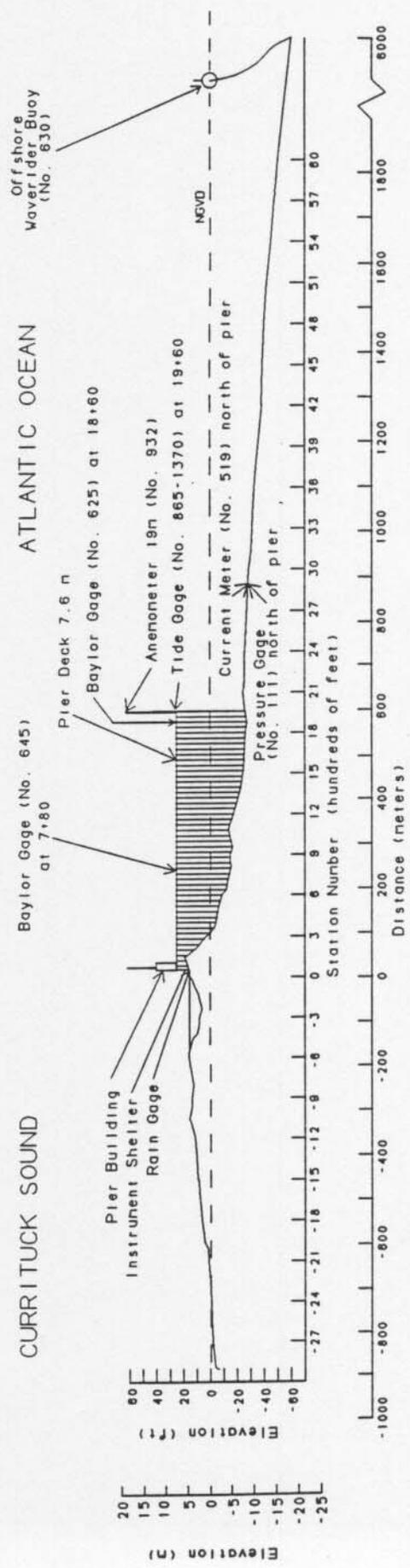


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $\text{mm} \times .03937 = \text{in.}$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $\text{mb} \times 0.02953 = \text{in. Hg}$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(\text{C} \times 9/5) + 32 = \text{F}$
4. Meters per second (m/s) to knots (kn) -  
 $\text{m/s} \times 1.943 = \text{kn}$

Table 2: Meteorological Data

Apr 1992

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed	Direction	deg C	Pressure	mm
		m/sec	deg TN		mb	
1	100	3	272	8.7	1009.5	0
	700	3	229	10.1	1009.7	0
	1300	6	187	16.2	1005.9	0
	1900	6	184	14.0	1001.3	0
2	100	15	342	10.3	1003.2	0
	700	7	308	5.8	1005.9	0
	1300	7	272	9.9	1004.5	0
	1900	10	301	8.4	1005.3	0
3	100	11	303	3.3	1008.3	0
	700	9	292	1.9	1010.2	0
	1300	2	1	7.7	1008.3	0
	1900	6	166	6.3	1006.4	0
4	100	7	239	7.4	1006.2	0
	700	4	21	7.1	1006.3	0
	1300	5	96	8.9	1003.7	0
	1900	7	32	6.0	1003.5	0
5	100	10	335	5.2	1005.3	0
	700	9	312	4.5	1010.1	0
	1300	7	3	9.8	1013.4	0
	1900	4	296	10.6	1015.2	0
6	100	6	307	8.7	1018.8	0
	700	4	309	8.1	1021.2	0
	1300	5	17	10.8	1020.6	0
	1900	5	163	8.4	1019.7	0
7	100	5	217	9.9	1018.6	0
	700	5	224	11.4	1017.1	0
	1300	4	214	20.5	1014.3	0
	1900	5	216	16.4	1012.4	0
8	100	4	224	14.3	1011.4	0
	700	5	268	14.5	1011.7	0
	1300	6	40	15.9	1013.0	0
	1900	4	85	11.8	1014.6	0
9	100	2	84	11.2	1017.2	0
	700	6	89	12.6	1018.0	0
	1300	9	144	16.7	1017.7	0
	1900	9	182	17.9	1016.8	0
10	100	6	198	17.2	1016.7	0
	700	6	215	17.2	1018.3	0
	1300	6	193	26.9	1017.4	0
	1900	9	177	20.5	1017.6	0
11	100	6	194	17.1	1017.4	0
	700	4	201	18.5	1018.2	0
	1300	2	119	21.0	1016.3	0
	1900	8	204	20.6	1015.6	0
12	100	6	215	19.0	1016.4	0
	700	4	213	18.4	1017.6	0
	1300	4	238	20.4	1016.4	0
	1900	11	343	14.4	1018.2	0
13	100	12	40	10.8	1022.8	0
	700	15	28	8.4	1027.3	0
	1300	13	26	7.7	1029.0	0
	1900	11	39	6.6	1027.4	0
14	100	8	39	7.2	1025.0	0
	700	7	47	7.9	1024.8	0
	1300	4	21	9.9	1023.2	0
	1900	5	62	7.8	1021.5	0
15	100	3	118	8.6	1021.4	0
	700	2	96	9.7	1022.8	0
	1300	1	75	13.8	1023.3	0
	1900	6	71	10.0	1022.7	0
16	100	4	121	10.7	1022.1	0
	700	4	147	12.6	1022.7	0
	1300	7	181	16.9	1020.9	0
	1900	9	190	17.9	1018.3	0

\* electronic problems

(Continued)

(Sheet 1 of 2)

Table 2: Meteorological Data

Apr 1992

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed	Direction	deg C	Pressure	mm
		m/sec	deg TN		mb	
17	100	8	207	18.1	1017.4	0
	700	8	208	18.1	1018.1	0
	1300	7	208	25.1	1016.3	0
	1900	9	194	20.5	1015.2	0
18	100	5	234	17.5	1017.3	0
	700	7	218	18.2	1017.8	0
	1300	5	125	18.9	1017.2	0
	1900	8	181	20.8	1017.0	0
19	100	5	202	18.4	1018.3	0
	700	1	104	14.1	1020.3	0
	1300	5	42	13.4	1019.5	0
	1900	5	50	11.8	1019.2	0
20	100	4	350	12.2	1019.1	0
	700	4	356	13.3	1019.1	0
	1300	2	76	17.8	1018.2	0
	1900	4	149	15.0	1016.7	0
21	100	6	165	20.1	1016.4	0
	700	9	151	17.0	1016.4	0
	1300	15	163	24.9	1015.1	0
	1900	11	172	20.9	1013.9	0
22	100	10	165	20.6	1013.7	0
	700	4	188	20.3	1015.9	10
	1300	9	184	23.9	1015.0	0
	1900	6	185	21.5	1014.6	0
23	100	3	264	19.9	1016.1	0
	700	6	344	18.0	1018.8	0
	1300	3	57	18.9	1019.0	0
	1900	4	145	15.4	1018.0	0
24	100	3	222	17.3	1016.1	0
	700	5	231	19.6	1014.6	0
	1300	5	208	27.1	1009.6	0
	1900	7	184	22.1	1004.5	0
25	100	8	200	23.1	1002.6	0
	700	6	305	18.0	1003.5	0
	1300	4	52	15.0	1003.6	0
	1900	6	63	12.8	1003.9	0
26	100	6	29	12.2	1005.0	0
	700	7	35	11.4	1005.9	0
	1300	7	35	10.5	1006.9	0
	1900	7	17	9.6	1009.3	0
27	100	5	352	9.1	1010.3	0
	700	4	326	10.2	1012.0	0
	1300	3	37	13.9	1011.8	0
	1900	1	119	11.9	1012.3	0
28	100	1	125	11.8	1011.9	0
	700	5	352	12.6	1011.9	0
	1300	11	29	12.4	1011.5	0
	1900	13	19	11.1	1011.7	0
29	100	14	12	10.4	1011.1	0
	700	15	13	10.5	1013.3	0
	1300	12	2	11.8	1015.1	0
	1900	5	17	10.1	1014.1	0
30	100	0		7.2	1014.1	0
	700	3	218	12.9	1013.9	0
	1300	9	138	16.4	1011.8	0
	1900	7	144	13.9	1011.5	0
		<u>Resultant</u>		<u>Mean</u>	<u>Mean</u>	<u>Total</u>
		0		13.9	1014.6	10

### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 3 hr. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The sampling rate is two times per second for five contiguous 34-min records.

Wave height  $H_{m0}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to optical disc.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{m0}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Apr 1992

Day	Hour	645		625		111		630	
		Baylor at 7+80		Baylor at 18+60		Pressure Gage		Offshsr Wvdr	
		Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec
1	0100	0.33	7.53	0.62	5.45	0.67	5.57	0.86	5.22
	0700	0.56	8.26	0.62	6.09	0.58	6.74	0.74	5.95
	1300	0.28	8.26	0.58	8.53	0.60	8.00	0.66	8.53
	1900	0.48	8.26	0.56	8.00	0.54	8.00	0.66	8.53
2	0100	1.03	4.92	1.32	4.83	1.34	4.92	1.64	5.12
	0700	0.78	5.33	0.83	6.09	0.88	6.09	1.01	6.24
	1300	0.45	5.45	0.83	5.45	0.81	5.45		*
	1900	0.51	5.22	0.60	4.83	0.59	4.92		*
3	0100	0.60	5.02	0.78	5.82	0.68	5.95		*
	0700	0.61	5.82	0.65	5.82	0.61	5.82	0.82	6.56
	1300	0.38	5.33	0.50	5.33	0.42	6.74	0.55	5.69
	1900	0.40	3.41	0.46	3.28	0.32	3.41	0.54	3.08
4	0100	0.19	4.83	0.20	7.76	0.19	7.76	0.32	6.92
	0700	0.40	3.20	0.43	3.16	0.21	3.41	0.43	3.28
	1300	0.30	4.74	0.36	4.83	0.31	4.83	0.35	4.49
	1900	0.55	2.98	0.60	3.20	0.33	3.41	0.61	3.37
5	0100	0.65	4.00	0.83	3.94	0.76	4.00	0.95	3.82
	0700	0.79	4.57	0.72	5.12	0.71	4.34	0.93	5.22
	1300	0.82	5.57	1.02	5.45	1.01	5.45	1.21	5.33
	1900	0.72	5.57	0.77	5.57	0.74	5.69	0.78	5.82
6	0100	0.27	5.45	0.52	5.33	0.55	6.09	0.65	6.09
	0700	0.63	4.49	0.80	4.57	0.77	4.41	0.89	5.02
	1300	0.49	5.12	0.83	5.69	0.81	8.53	0.96	6.09
	1900	0.68	5.69	0.87	5.82	0.92	7.11	1.09	6.92
7	0100	0.22	6.74	0.65	12.80	0.66	7.31	0.79	7.11
	0700	0.24	12.80	0.65	11.13	0.78	12.19	0.75	12.19
	1300	0.23	11.64	0.67	11.64	0.70	12.19	0.74	11.64
	1900	0.45	12.19	0.82	12.19	0.90	12.19	0.92	12.19
8	0100	0.55	12.19	0.82	12.19	0.87	12.80	0.95	11.64
	0700	0.34	12.80	0.93	12.80	0.92	12.19	0.96	12.19
	1300	0.59	12.80	0.84	12.80	0.89	12.80	0.99	12.80
	1900	0.37	12.19	0.78	11.64	0.95	11.64	0.85	12.19
9	0100	0.51	12.80	0.69	12.19	0.69	12.19	0.74	11.64
	0700	0.35	12.19	0.70	12.19	0.69	11.64	0.73	11.13
	1300	0.60	11.64	0.67	10.24	0.71	11.64	0.76	11.13
	1900	0.38	5.69	0.64	12.19	0.68	10.67	0.82	5.69
10	0100	0.57	5.69	0.64	12.80	0.62	11.64	0.73	6.56
	0700	0.44	5.22	0.61	12.19	0.60	11.64	0.70	5.69
	1300	0.50	5.22	0.50	12.19	0.53	11.64	0.59	11.64
	1900	0.32	5.33	0.48	11.64	0.47	12.19	0.54	11.13
11	0100	0.41	10.24	0.44	12.80	0.48	12.19	0.52	11.64
	0700	0.33	4.49	0.46	9.85	0.44	9.85	0.53	11.13
	1300	0.46	12.19	0.48	12.80	0.47	12.80	0.55	12.80
	1900	0.46	5.95	0.48	11.64	0.50	12.19	0.63	6.09
12	0100	0.64	5.82	0.52	5.45	0.55	5.69	0.64	5.82
	0700	0.32	5.33	0.47	12.19	0.48	11.64	0.56	11.64
	1300	0.56	5.45	0.50	12.19	0.53	9.48	0.60	11.64
	1900	0.26	5.69	0.48	9.48	0.53	8.83	0.62	11.64
13	0100	1.25	4.83	1.44	5.02	1.38	5.02	1.57	4.92
	0700	1.48	6.92	2.27	7.11	2.43	6.74	2.66	6.92
	1300	1.64	7.53	2.57	8.00	2.77	8.26	2.89	8.26
	1900	1.46	7.76	1.81	8.00	1.94	7.76	2.03	7.76
14	0100	1.01	7.76	1.51	8.26	1.61	8.00	2.29	7.76
	0700	1.02	6.92	1.30	7.53	1.35	7.76	1.52	6.74
	1300	0.62	5.95	1.14	8.53	1.17	9.14	1.36	8.83
	1900	0.89	8.53	1.02	8.83	1.04	8.83	1.42	9.14
15	0100	0.71	8.53	0.99	8.83	1.07	8.53	1.15	8.83
	0700	0.73	9.14	0.92	8.83	0.88	8.53	1.00	8.53
	1300	0.58	9.48	0.83	8.83	0.82	8.83	0.97	8.26
	1900	0.64	8.26	0.81	8.53	0.74	7.76	0.90	8.26
16	0100	0.56	8.26	0.80	8.26	0.77	8.53	0.86	8.53
	0700	0.63	8.83	0.68	8.53	0.69	8.53	0.81	9.14
	1300	0.53	5.22	0.70	7.76	0.69	9.14	0.81	8.53
	1900	0.82	5.69	0.87	5.69	0.80	5.69	1.07	5.33

\* Electronic problems

(Continued)

(Sheet 1 of 2)

Table 3: Wave Data

Apr 1992

Day	Hour	645		625		111		630	
		Baylor at 7+80		Baylor at 18+60		Pressure Gage		Offshr Wvrdr	
		Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec
17	0100	0.62	6.09	0.71	6.56	0.72	8.00	0.99	6.24
	0700	0.80	6.92	0.64	7.31	0.70	6.56	0.88	6.92
	1300	0.51	6.24	0.54	8.53	0.57	6.40	0.72	6.92
	1900	0.65	6.09	0.59	8.26	0.63	9.14	0.83	6.09
18	0100	0.39	5.95	0.45	9.14	0.47	9.14	0.61	9.85
	0700	0.55	9.14	0.51	8.00	0.52	9.48	0.58	9.48
	1300	0.38	5.45	0.38	9.14	0.39	9.14	0.51	9.14
	1900	0.42	8.53	0.46	8.00	0.42	8.26	0.55	8.53
19	0100	0.29	6.09	0.44	8.26	0.46	6.09	0.61	5.57
	0700	0.69	5.45	0.62	5.45	0.61	5.57	0.68	5.57
	1300	0.44	5.45	0.65	5.69	0.63	8.26	0.80	5.57
	1900	0.76	5.69	0.79	5.45	0.77	5.69	0.89	5.02
20	0100	0.40	5.22	0.68	5.12	0.69	8.83	0.80	5.45
	0700	0.69	5.33	0.74	5.33	0.71	5.45	0.84	8.26
	1300	0.35	5.57	0.70	8.00	0.70	8.83	0.85	7.53
	1900	0.70	5.82	0.75	8.83	0.75	8.26	0.88	8.53
21	0100	0.67	6.09	0.84	9.14	0.89	6.24	1.02	5.82
	0700	0.63	6.40	0.93	6.24	0.93	6.09	1.14	5.95
	1300	0.70	6.40	0.96	8.53	1.04	10.24	1.29	6.92
	1900	0.70	6.56	0.88	6.56	0.88	6.74	1.15	6.56
22	0100	0.88	6.56	0.92	9.85	0.90	6.92	1.19	7.11
	0700	0.63	7.11	0.87	7.31	0.98	7.53	1.10	7.31
	1300	0.65	7.76	0.80	7.31	0.90	7.76	1.10	7.31
	1900	0.57	6.92	0.83	7.53	0.89	7.11	1.03	7.53
23	0100	0.82	6.74	0.82	6.74	0.86	11.13	0.98	7.11
	0700	0.45	5.82	0.69	7.76	0.74	10.67	0.82	6.74
	1300	0.50	6.56	0.58	11.13	0.61	10.67	0.72	8.26
	1900	0.35	12.19	0.68	12.19	0.76	12.80	0.80	12.80
24	0100	0.85	11.64	0.84	11.64	0.95	11.64	1.07	11.64
	0700	0.65	11.64	0.91	11.64	0.91	11.13	1.22	10.67
	1300	0.80	11.13	0.84	10.67	1.02	11.13	1.07	11.13
	1900	0.63	10.67	0.95	10.67	0.93	11.13	1.11	11.13
25	0100	0.73	11.13	0.76	10.67	0.76	10.67	0.83	10.67
	0700	0.28	10.67	0.69	10.24	0.71	10.24	0.82	10.24
	1300	0.61	9.85	0.71	9.85	0.64	10.24	0.75	10.24
	1900	0.36	9.85	0.64	9.85	0.57	9.85	*	
26	0100	0.71	9.14	0.87	9.48	0.71	9.48	1.01	9.48
	0700	0.64	4.41	0.97	5.02	0.89	9.14	1.03	4.34
	1300	1.14	5.57	1.22	5.33	1.24	5.33	1.37	5.45
	1900	0.86	5.82	1.05	5.45	1.09	5.82	1.27	5.95
27	0100	0.79	4.57	1.02	8.26	1.02	8.26	1.10	8.83
	0700	0.52	5.33	0.89	8.83	0.98	8.26	1.03	8.83
	1300	0.69	9.85	0.97	9.48	1.00	9.48	1.08	9.48
	1900	0.43	16.00	0.87	9.48	1.06	9.85	1.00	8.83
28	0100	0.64	16.00	0.91	16.00	1.00	9.48	1.06	7.31
	0700	0.48	16.00	0.93	9.85	0.93	9.85	1.00	9.85
	1300	1.10	3.88	1.33	4.27	1.28	3.77	1.45	9.48
	1900	1.35	5.69	1.72	5.95	1.90	5.33	1.98	5.45
29	0100	1.54	5.45	2.17	6.92	2.28	6.74	2.57	5.57
	0700	1.83	6.56	2.46	9.85	2.78	9.14	3.04	9.14
	1300	2.20	10.67	2.72	10.67	2.74	9.48	2.96	9.85
	1900	1.84	8.83	2.18	11.13	2.08	9.48	2.04	10.67
30	0100	1.19	12.19	1.84	11.64	1.91	10.67	1.99	9.48
	0700	1.53	11.13	1.75	11.64	1.87	11.64	1.91	11.64
	1300	1.02	11.64	1.67	10.67	1.83	10.67	1.79	10.67
	1900	1.26	11.64	1.55	11.64	1.49	11.64	1.66	11.64
	Mean	0.67	7.60	0.88	8.50	0.90	8.50	1.04	8.14
	Std dev	0.36	2.93	0.46	2.73	0.50	2.50	0.53	2.48

\* Electronic problems

(Sheet 2 of 2)

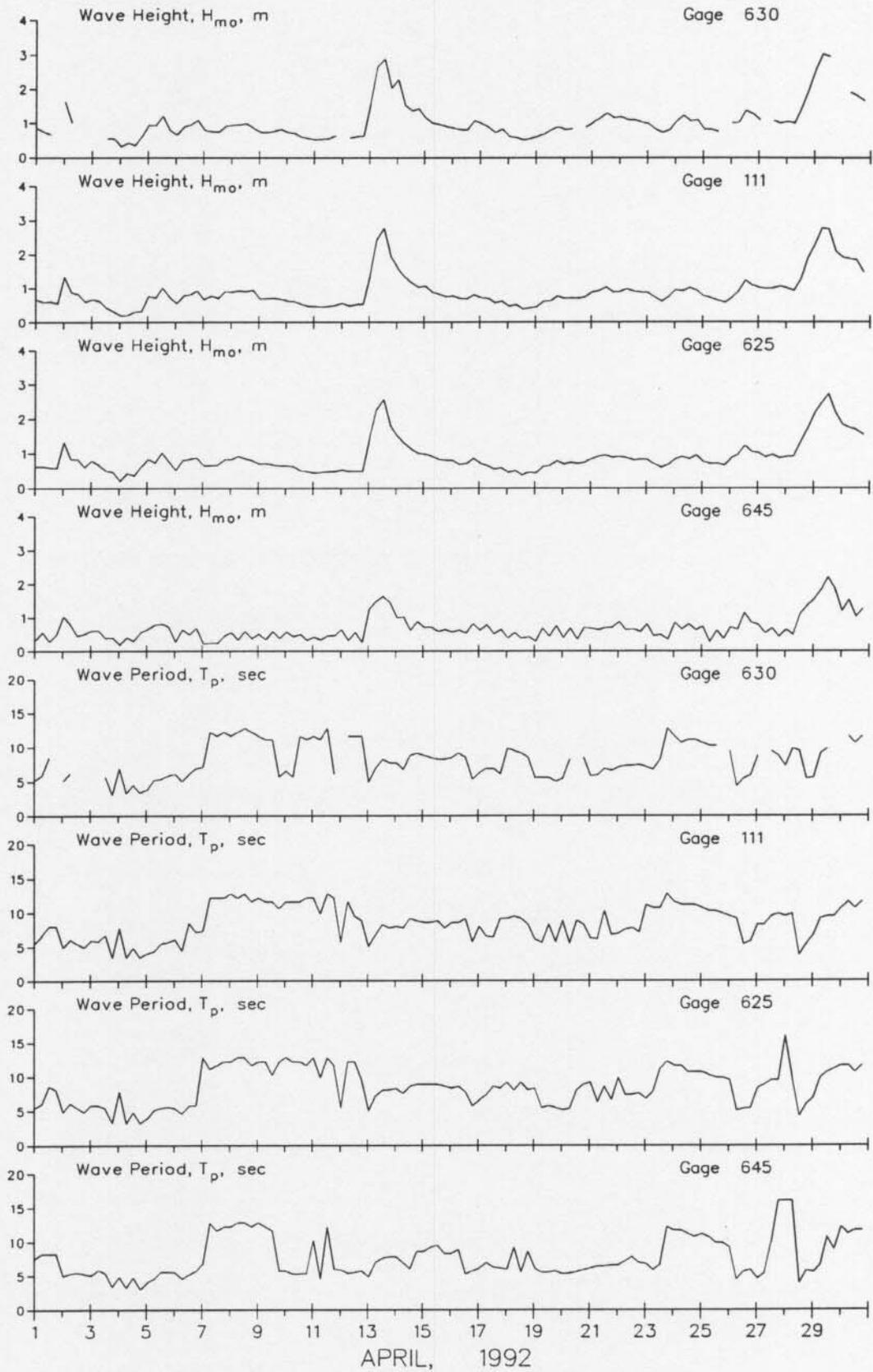


Figure 3. Time history of wave heights and periods

#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

#### IMPORTANT NOTE

Direction resultants regarding the current meter data (gages 519 and 529) may be in error by minus 19 or 20 degrees. Despite our efforts, we have yet to determine the cause of this error. Please call us if you must use this data.

Table 4: Current Data  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed
1	0100	-Along Cross Result									18 S 10 off 21 132
1	0700	-Along Cross Result	18 S 2 off 18 154		140	3 S 10 off 11 88		3 S	North	14 S 9 off 17 129	
1	1300	-Along Cross Result									
1	1900	-Along Cross Result									
2	0100	-Along Cross Result									
2	0700	-Along Cross Result	34 S 3 off 34 154		140	47 S 5 on 47 166		65 S	North		
2	1300	-Along Cross Result									
2	1900	-Along Cross Result								19 S 5 off 19 145	
3	0100	-Along Cross Result								19 S 6 off 20 142	
3	0700	-Along Cross Result	29 S 3 off 29 154		140	30 S 0 on 30 160		18 S	North	9 S 3 off 9 143	
3	1300	-Along Cross Result								6 S 4 off 7 126	
3	1900	-Along Cross Result								7 N 2 on 7 325	
4	0100	-Along Cross Result								7 N 5 on 9 303	
4	0700	-Along Cross Result	27 S 0 off 27 160		128	15 S 0 on 15 160		5 S	North	7 N 3 off 7 6	
4	1300	-Along Cross Result								2 N 1 off 2 359	
4	1900	-Along Cross Result								14 N 0 off 14 340	
5	0100	-Along Cross Result								10 S 4 off 11 138	
5	0700	-Along Cross Result	38 S 0 off 38 160		189	30 S 3 on 31 166		61 S	North	15 S 4 off 16 144	
5	1300	-Along Cross Result								23 S 9 off 25 140	
5	1900	-Along Cross Result								9 S 2 off 10 146	

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
6	0100	-Along Cross Result								7 4 8	S off 131	
6	0700	-Along Cross Result	47 0 47	S	140	87 0 87	S	North	27	S	13 4 13	S off 141
6	1300	-Along Cross Result								24 10 26	S off 137	
6	1900	-Along Cross Result								10 9 14	S off 119	
7	0100	-Along Cross Result								11 4 11	S off 141	
7	0700	-Along Cross Result	8 0 8	S	140	20 30 37	N off	South	3	N	1 2 3	S off 99
7	1300	-Along Cross Result								8 2 8	S off 143	
7	1900	-Along Cross Result								4 3 5	S off 120	
8	0100	-Along Cross Result								6 4 7	S off 126	
8	0700	-Along Cross Result	0 0 0		140	21 19 28	N off	South	9	N	0 2 2	on 250
8	1300	-Along Cross Result								3 13 13	N off 58	
8	1900	-Along Cross Result								3 2 4	N on 308	
9	0100	-Along Cross Result								6 1 6	S off 146	
9	0700	-Along Cross Result	20 6 21	N on	140	68 0 68	N	South	18	N	8 4 9	N off 8
9	1300	-Along Cross Result								5 2 5	S off 136	
9	1900	-Along Cross Result								1 7 7	S on 241	
10	0100	-Along Cross Result								4 2 5	N on 311	
10	0700	-Along Cross Result	8 10 13	N off	140	87 26 91	N off	South	18	N	4 2 5	N on 310
10	1300	-Along Cross Result								3 2 4	N off 14	
10	1900	-Along Cross Result								4 4 6	N on 299	

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed		
11	0100	-Along Cross Result								11 6 13	N on 313
11	0700	-Along Cross Result	17 7 19	N off 2	154	24 27 36	N off 28	South	28	8 3 8	N on 320
11	1300	-Along Cross Result								7 0 7	N  340
11	1900	-Along Cross Result								1 2 3	N on 276
12	0100	-Along Cross Result								7 3 8	N on 318
12	0700	-Along Cross Result	8 8 11	N off 22	162	25 18 31	N off 15	South	9	4 1 4	S on 176
12	1300	-Along Cross Result								0 3 3	 on 250
12	1900	-Along Cross Result								5 10 11	S off 99
13	0100	-Along Cross Result								11 6 12	S off 132
13	0700	-Along Cross Result	87 9 88	S off 154	140	203 0 203	S  160	North	35	38 19 43	S off 134
13	1300	-Along Cross Result								54 23 59	S off 137
13	1900	-Along Cross Result								43 19 47	S off 137
14	0100	-Along Cross Result								23 11 25	S off 134
14	0700	-Along Cross Result	34 0 34	S  160	140	51 0 51	N  340	North	21	38 15 40	S off 138
14	1300	-Along Cross Result								22 12 25	S off 131
14	1900	-Along Cross Result								18 10 20	S off 132
15	0100	-Along Cross Result								3 3 4	S off 118
15	0700	-Along Cross Result	5 2 5	N on 318	140	38 11 40	N off 357	South	8	3 5 6	N off 42
15	1300	-Along Cross Result								7 4 8	N off 11
15	1900	-Along Cross Result								5 5 7	S off 119

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
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Table 4: Current Data (Continued)  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements					Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir	
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed			Dir
16	0100	Along Cross Result									3 2 4	S off 123
16	0700	Along Cross Result	12 0 12	N off 340	140	30 0 30	N off 340	South	2 N		10 7 12	S off 125
16	1300	Along Cross Result									5 0 5	S on 160
16	1900	Along Cross Result									1 2 2	S on 223
17	0100	Along Cross Result									4 6 7	N on 282
17	0700	Along Cross Result	30 9 32	N off 357	140	30 0 30	N off 340	South	16 N		7 7 10	N on 296
17	1300	Along Cross Result									8 6 10	N on 305
17	1900	Along Cross Result									10 5 11	N on 312
18	0100	Along Cross Result									7 4 8	N on 308
18	0700	Along Cross Result	0 7 7	off 70	142	12 4 13	N off 357	South	21 N		2 4 4	N on 278
18	1300	Along Cross Result									6 3 6	S off 135
18	1900	Along Cross Result									3 2 4	S off 128
19	0100	Along Cross Result									8 4 9	S off 135
19	0700	Along Cross Result	22 4 22	S on 171	152	9 0 9	S off 160	North	16 S		10 7 12	S off 124
19	1300	Along Cross Result									22 13 26	S off 130
19	1900	Along Cross Result									13 10 16	S off 122
20	0100	Along Cross Result									20 8 22	S off 138
20	0700	Along Cross Result	23 0 23	S on 160	140	27 0 27	S off 160	North	10 S		13 6 14	S off 133
20	1300	Along Cross Result									35 15 38	S off 137
20	1900	Along Cross Result									13 4 14	S off 144

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
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Table 4: Current Data (Continued)  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements					Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)			Speed	Dir	
			Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir	
21	0100	-Along Cross Result									13 6 14	S off 136
21	0700	-Along Cross Result	12 0 12	N  340	140	122 30 126	N on 326	North	47	N	9 3 9	S off 139
21	1300	-Along Cross Result									27 4 27	N on 331
21	1900	-Along Cross Result									19 13 23	N on 306
22	0100	-Along Cross Result									13 6 14	N on 316
22	0700	-Along Cross Result	24 0 24	N  340	140	102 30 106	N on 323	South	36	N	13 8 16	N on 308
22	1300	-Along Cross Result									5 5 7	N on 297
22	1900	-Along Cross Result									13 6 14	N on 314
23	0100	-Along Cross Result									11 4 12	N on 321
23	0700	-Along Cross Result	0 0 0	  0	140	44 44 62	N on 295	South	19	N	7 1 7	N off 349
23	1300	-Along Cross Result									5 2 6	S off 141
23	1900	-Along Cross Result									1 0 1	S  160
24	0100	-Along Cross Result									5 0 5	N  340
24	0700	-Along Cross Result	41 16 44	S off 138	152	61 37 71	N on 309	South	43	N	1 12 12	N off 65
24	1300	-Along Cross Result									18 5 18	S off 145
24	1900	-Along Cross Result									6 2 7	S on 175
25	0100	-Along Cross Result									9 0 9	N  340
25	0700	-Along Cross Result	22 10 24	S on 184	177	41 4 41	N off 346	South	17	N	5 2 6	N on 317
25	1300	-Along Cross Result									2 17 17	S off 75
25	1900	-Along Cross Result									8 0 8	N  340

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Table 4: Current Data (Concluded)  
Apr 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements					Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)			Speed	Dir	
			Speed	Dir	Speed	Dir	Location	Speed	Dir			
26	0100	-Along Cross Result									2 2 3	N off 22
26	0700	-Along Cross Result	22 0 22	S	191	20 18 26	S on 202	18	S	North	9 7 11	S off 125
26	1300	-Along Cross Result									30 16 34	S off 133
26	1900	-Along Cross Result									29 14 32	S off 135
27	0100	-Along Cross Result									37 20 42	S off 132
27	0700	-Along Cross Result	36 0 36	S	140	34 0 34	S off 160	3	N	North	25 13 28	S off 133
27	1300	-Along Cross Result									21 1 21	S on 162
27	1900	-Along Cross Result									12 3 13	S off 147
28	0100	-Along Cross Result									6 3 7	N on 314
28	0700	-Along Cross Result	34 0 34	S	140	25 25 36	N off 25	18	N	South	6 4 7	N off 15
28	1300	-Along Cross Result									36 14 38	S off 139
28	1900	-Along Cross Result									51 20 55	S off 138
29	0100	-Along Cross Result									57 18 59	S off 142
29	0700	-Along Cross Result	76 0 76	S	140	152 0 152	S off 160	29	S	North	66 21 69	S off 142
29	1300	-Along Cross Result									53 18 56	S off 141
29	1900	-Along Cross Result									23 2 23	S on 165
30	0100	-Along Cross Result									22 7 23	S off 142
30	0700	-Along Cross Result	0 2 2	off 70	140	87 0 87	N off 340	15	N	South	5 2 5	S off 135
30	1300	-Along Cross Result									11 2 11	N off 352
30	1900	-Along Cross Result									12 5 13	N on 317

KEY = All speeds in cm/sec  
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## PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Apr 1992

Day	Time	Wave Approach Angle at Pier End deg from True N		Radar Wave Angle deg from True N	Width of Surf Zone,m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	0827	60			53	9.4	1.0231	2.1
2	0712	40		50	45	8.9	1.0234	1.5
3	0811	30		50	26	8.9	1.0236	1.8
4	0930	10			2	8.9	1.0234	1.5
5	1000	5		30	73	8.9	1.0238	1.5
6	1130	40		80	61	9.4	1.0238	2.1
7	0739	75			67	8.9	1.0232	2.4
8	0759	75			55	9.4	1.0228	2.7
9	0758	80		80	62	11.1	1.0228	3.0
10	0640	85			61	8.9	1.0247	1.5
11	0820	95	125		23	8.9	1.0252	2.4
12	0830	90	130		29	8.9	1.0256	2.1
13	0713	55		60	496	8.3	1.0260	0.6
14	0710	65		75	122	10.0	1.0238	1.5
15	0607	75			62	10.6	1.0226	1.8
16	0628	80	75		61	11.7	1.0226	2.4
17	0716	90	110		43	10.0	1.0250	1.2
18	0945	115			33	10.6	1.0250	1.8
19	0856	110			40	11.7	1.0250	3.4
20	0716	45			48	11.7	1.0244	4.0
21	0722	80		80	69	12.8	1.0233	2.1
22	0712	85			68	12.2	1.0241	1.2
23	0714	75	110		60	10.6	1.0249	2.4
24	1100	120			61	15.0	1.0224	1.8
25	0920	75			53	12.2	1.0246	2.7
26	0900	35		73	80	13.3	1.0240	2.4
27	0715	60			63	13.9	1.0212	1.8
28	0635	70		75	70	14.4	1.0210	2.4
29	0721	60		60	406	13.3	1.0199	1.5
30	0652	80			308	13.3	1.0198	1.2

## PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

Table 6: Water Levels,m NGVD

		Apr 1992			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	942	-0.33	0.61	0.15	0.94
1	2207	-0.30	0.78	0.25	1.09
2	1032	-0.23	0.87	0.30	1.10
2	2257	-0.38	0.86	0.31	1.25
3	1122	-0.41	0.66	0.10	1.08
3	2348	-0.55	0.71	0.12	1.25
4	1213	-0.49	0.55	0.00	1.05
5	38	-0.47	0.77	0.16	1.23
5	1303	-0.42	0.56	0.06	0.98
6	128	-0.47	0.74	0.16	1.21
6	1354	-0.43	0.47	0.01	0.90
7	219	-0.42	0.76	0.18	1.19
7	1444	-0.38	0.45	0.02	0.83
8	309	-0.30	0.76	0.24	1.06
8	1534	-0.28	0.54	0.10	0.82
9	400	-0.27	0.75	0.25	1.01
9	1625	-0.32	0.45	0.07	0.78
10	450	-0.38	0.64	0.17	1.03
10	1715	-0.37	0.46	0.03	0.82
11	540	-0.44	0.58	0.11	1.02
11	1806	-0.45	0.44	0.01	0.89
12	631	-0.42	0.57	0.08	0.99
12	1856	-0.44	0.57	0.10	1.00
13	721	-0.42	0.82	0.25	1.24
13	1946	-0.39	0.80	0.22	1.19
14	812	-0.53	0.75	0.14	1.27
14	2037	-0.53	0.75	0.13	1.28
15	902	-0.71	0.52	-0.08	1.23
15	2127	-0.72	0.75	0.04	1.47
16	952	-0.72	0.57	-0.06	1.29
16	2217	-0.73	0.73	0.03	1.46
17	1043	-0.73	0.46	-0.15	1.19
17	2308	-0.77	0.68	0.02	1.46
18	1133	-0.79	0.50	-0.08	1.29
18	2358	-0.49	0.86	0.21	1.35
19	1223	-0.43	0.55	0.04	0.98
20	49	-0.37	0.86	0.25	1.24
20	1314	-0.37	0.49	0.04	0.87
21	139	-0.35	0.71	0.18	1.06
21	1404	-0.39	0.45	0.00	0.84
22	229	-0.41	0.59	0.12	1.00
22	1455	-0.39	0.37	-0.04	0.75
23	320	-0.38	0.48	0.07	0.87
23	1545	-0.36	0.27	-0.04	0.63
24	410	-0.37	0.47	0.05	0.84
24	1635	-0.36	0.32	0.00	0.68
25	501	-0.23	0.50	0.10	0.73
25	1726	-0.21	0.53	0.21	0.74
26	551	-0.05	0.67	0.35	0.72
26	1816	0.05	0.69	0.40	0.64
27	641	-0.07	0.70	0.36	0.78
27	1907	-0.17	0.61	0.26	0.77
28	732	-0.22	0.53	0.15	0.75
28	1957	-0.19	0.78	0.34	0.97
29	822	-0.08	0.82	0.38	0.90
29	2047	-0.11	1.00	0.45	1.11
30	913	-0.34	0.68	0.20	1.01
30	2138	-0.39	0.79	0.26	1.18

# FRF Tide Heights

Apr 1992

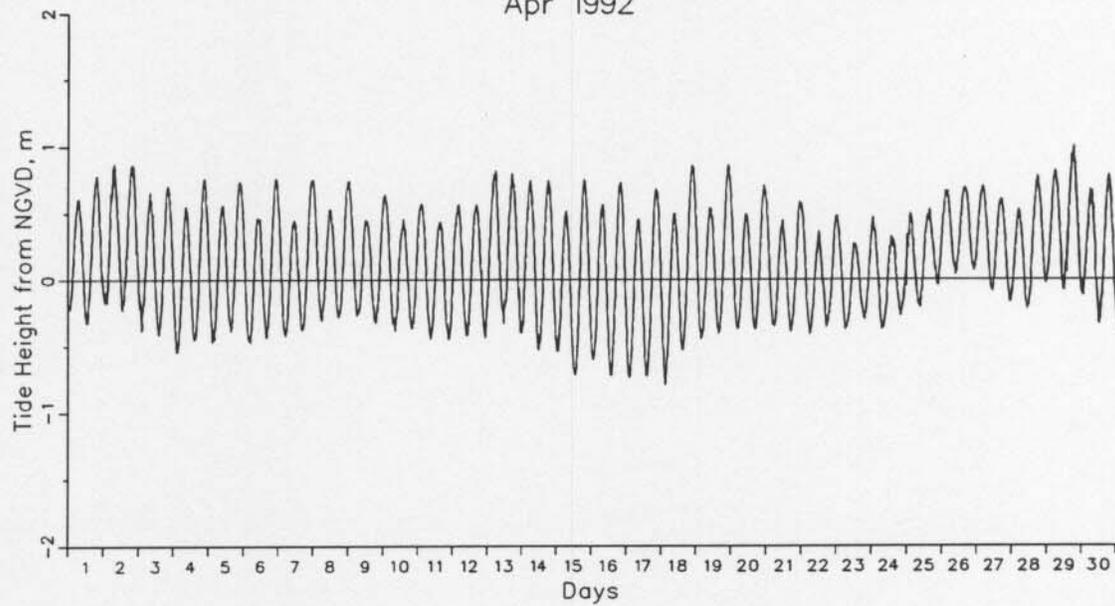


Figure 4. Water level time history

### Monthly Water Levels, m NGVD

Extreme Low = -0.79 on day 18 at 154 EST  
Extreme High = 1.00 on day 29 at 1718 EST  
Monthly Mean = 0.13  
Mean Low = -0.39  
Mean High = 0.63  
Mean Range = 1.02

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Geodimeter surveying system; a Geodimeter 140-T self-tracking, electronic theodolite, distance meter, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

During April the CRAB was dedicated to working on a special project and was unavailable for surveying. Figures 5 and 6 are the March survey and are included for reference.

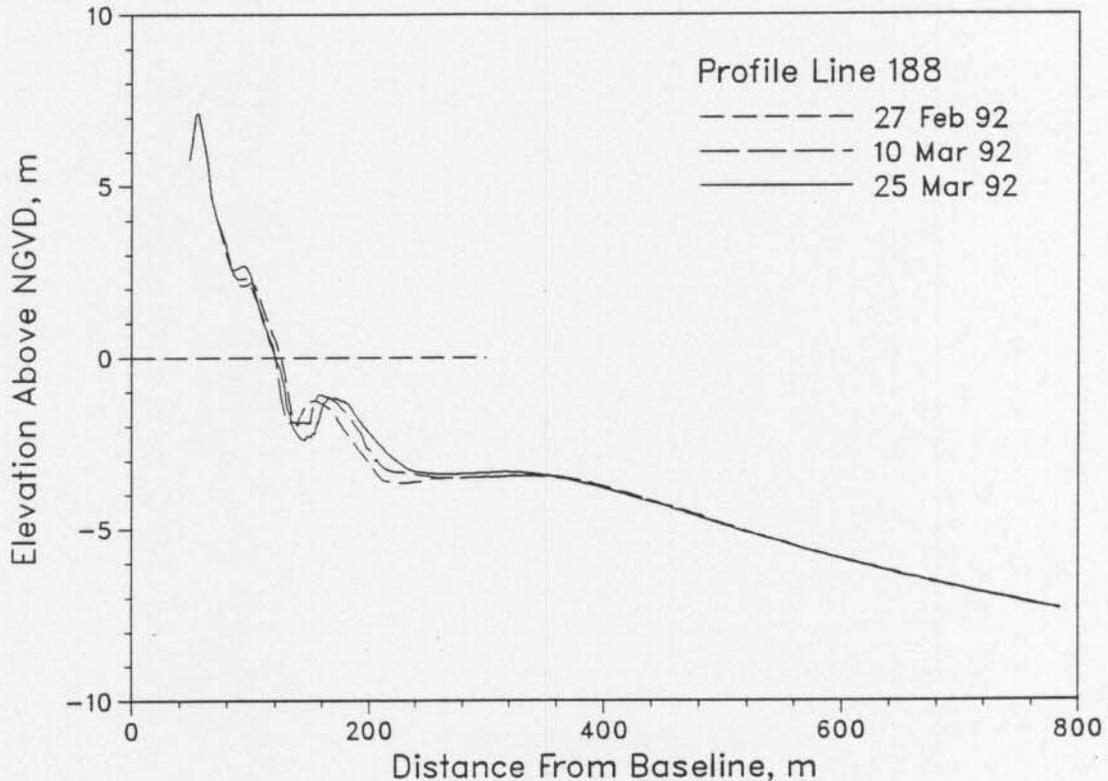


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

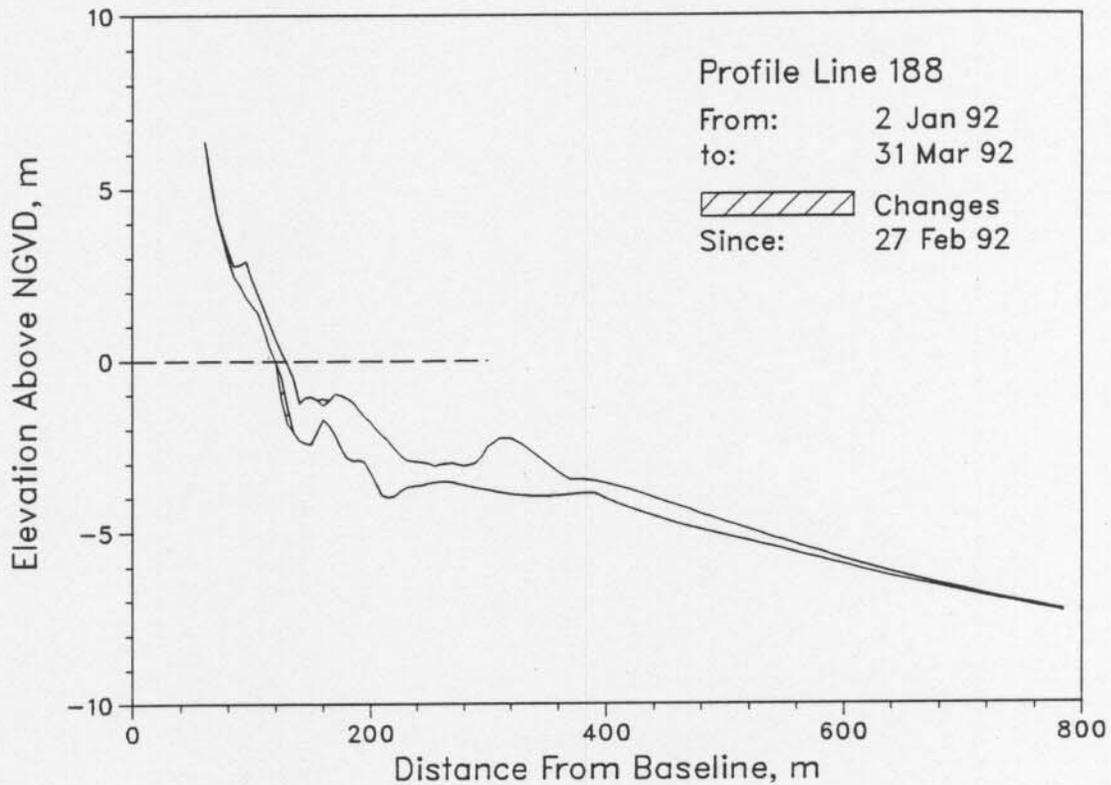


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 25 March. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

Figure 7 is included for reference. There was no survey during the month of April.

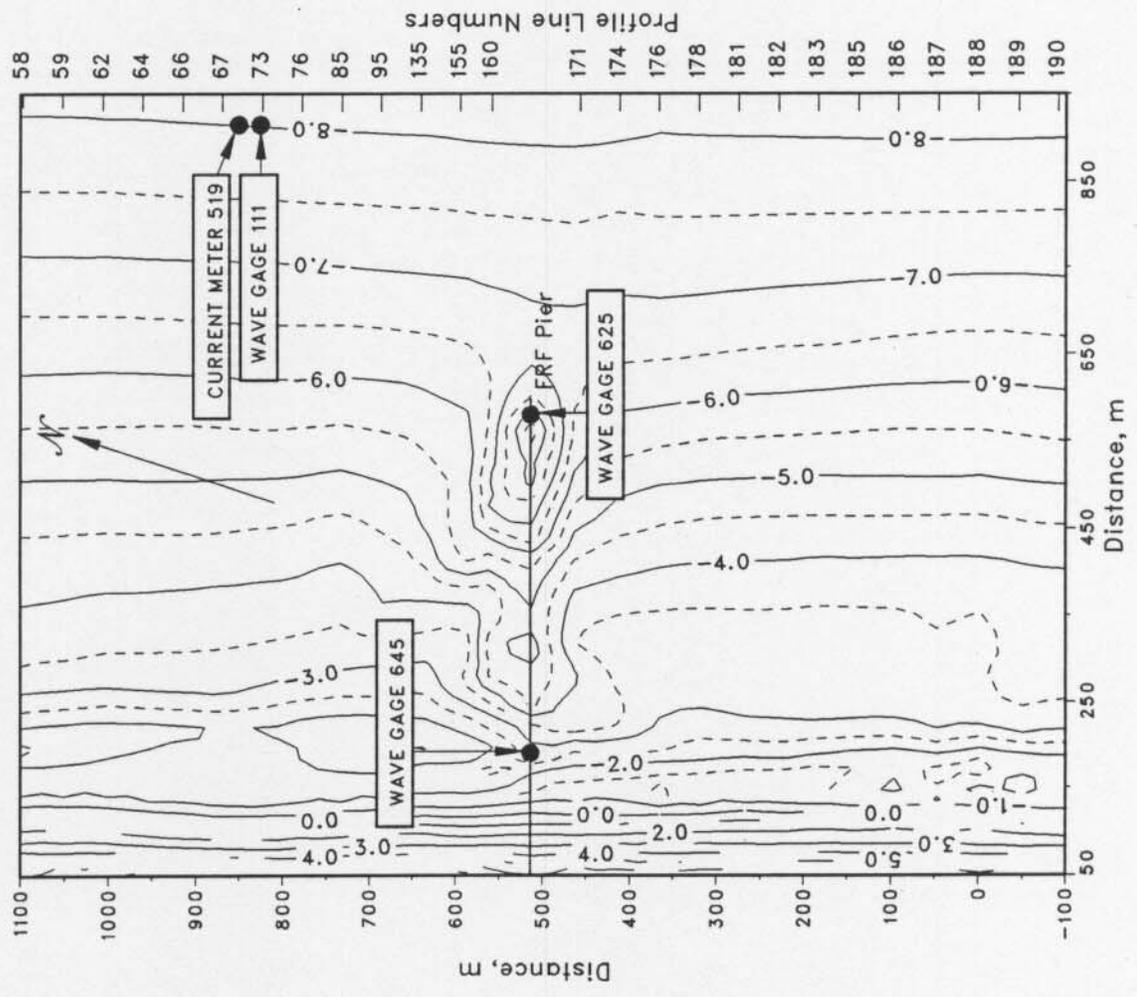
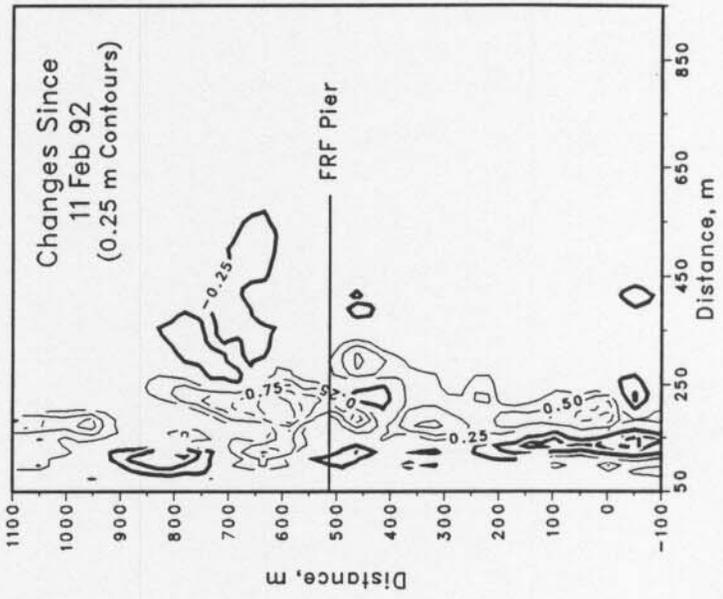
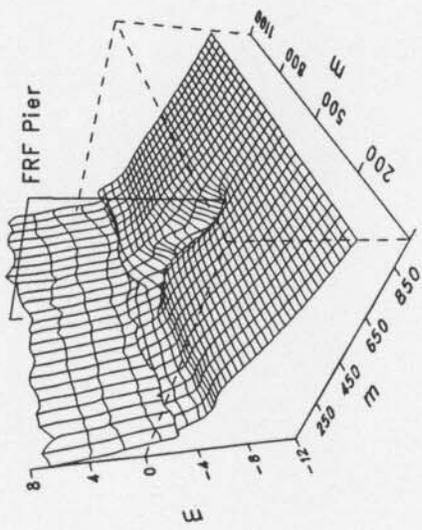


Figure 7. FRF bathymetry 25 Mar 92 depths relative to NGVD

## PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height  $H_{m0}$  at the seaward end of the pier (i.e. as measured near the end of the pier) exceeded 2 m.

<u>Start</u>	<u>End</u>
13 Apr (0316)	13 Apr (2342)
28 Apr (1934)	30 Apr (0734)

### B. Storm Synopsis.

13 April A low pressure system formed off the Florida coast and headed seaward. The maximum  $H_{m0}$  (at gage 625) of 2.6 meters ( $T_p = 7.0$  sec) was measured at 0842 EST on 13 April. Maximum winds (from northeast) reached 15.5 m/s on 13 April at 0616 EST. Atmospheric pressure was not affected due to the storm system remaining well offshore. Nor was there any precipitation.

28-30 April A low pressure system formed off the Carolina coast and headed seaward. The maximum  $H_{m0}$  (at gage 625) of 2.6 meters ( $T_p = 10.2$  sec) was measured at 1108 EST on 29 April. Maximum winds (from northeast) reached 15.0 m/s on 29 April at 0542 EST. Atmospheric pressure was not affected during either storm due to the storm system remaining well offshore. Nor was there any precipitation.

Distribution List

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